CSF LEAK AND ENDOSCOPIC SINUS SURGERY
Outline

- Anatomy
- Diagnosis intra-op
- Diagnosis post-op
- Treatment/Management
- Cases
Question

- Important Anatomical Considerations
Anatomy

Hosemann, W and Draf C. Danger points, complications and medico-legal aspects in endoscopic sinus surgery. GMS Current Topics Otorhinolaryngology Head and Neck Surgery...
Maxillary/Ethmoid Height

- Ratio of maxillary-to-ethmoid height, vary 1:1 to 2:1

Fovea Ethmoidalis and Orbit

Figure Fig. 3.. Low sloping fovea. Arrow indicates a low sloping fovea extending to the midorbital plane.

Figure Fig. 4.. Low fovea with narrow angle between medial orbital wall and fovea. Arrow indicates narrow angle.

Meyers, R and Valvassori, G. Interpretation of anatomic variations of computed tomography scans of the sinuses: a surgeon’s perspective. Laryngoscope
Rudmik, L and Smith, T. Evaluation of the Ethmoid Skull Base Height Prior to Endoscopic Sinus Surgery: A Preoperative CT evaluation Technique. International Forum of Allergy and Rhinology.

High: > 7 mm. = 70% patients
Moderate: 4 - 7 mm. = 25% patients
Low: < 4 mm. = 5% patients
Keros Classification

Palmer, J and Chiu, A. Atlas of Endoscopic Sinus and Skull Base Surgery
Keros Classification
Anatomic Variants

- a. Position of the ethmoid roof beneath the roof of the orbit.
- b. Asymmetry of the ethmoid roof.
- c. Asymmetry regarding the height of the ethmoid roof (in 2/3 the right side is lower than the left).
- d. Deep position of the cribriform plate, i.e. high lateral lamella of the olfactory fossa.
- e. Larger angle between the skull base and the horizontal line through the sagittal plane.
Epidemiology

- <1%
- Posterior Ethmoid Roof
- Lateral lamella of the cribiform plate
- Single most important risk factor - prior FESS
- 3402 patients
- 19 leaks
- 71% prior surgery
- 82% image guidance*
- 11% polyps
- 13% Keros grade 3
Surgery
Diagnosis- intraop

- Clear fluid
- Pulsating dura/brain
- Increase in bleeding
Definition

Pia/Brain
Arachnoid
Dura mater
Cranial bone
Mucoperiosteum
Management

- Stop, lightly pack nose with pledgets in 1:100,000 epinephrine over site
- Flatten table
- Dose of Ceftriaxone
- Review Scan
- Hemostasis
- Identify leak

Reefy, H and Hopkins, C. Up to date expert opinion referencing the best evidence available on intraoperative cerebrospinal fluid leak during endoscopic sinus surgery. Clinical Otolaryngology.
Leak

- Cannot identify location
- Identify leak but minimal repair
- Identify but do not feel comfortable with repair
- Identify with large repair
Conservative Management

- Deep extubation
- Antiemetics
- Elevate Head of Bed
- No straining, nose blowing, heavy lifting
- Lumbar drain?
- Antibiotics?
- Post op Imaging
- Counseling
- Re-evaluate

Repair

- Prepare site
  - Maxillary antrostomy, total ethmoidectomy, poss middle turbinate
  - Strip mucosa
- Measure, Consider shrinkage of graft

- Grafts
  - Overlay, Underlay, Combined
  - Cartilage, bone, mucoperichondrium, mucosa, fascia, fat, synthetic materials
Repair

- **Size**
  - <2mm
    - Osteoneogenesis, fibrosis, overlay graft
  - 2-5mm
    - Composite graft
  - >5mm
    - multilayered

Bath-plug technique

- Prepare site
- Harvest fat (earlobe, abdomen)
- Same diameter as defect, 2-3x long
- Mucosa graft harvested (lateral nasal wall)
- 4-0 Vicryl suture
- Ball probe to place fat
- Mucosal graft over defect
- Fibrin glue

Composite

- Middle turbinate graft
  - Resect at skull base
  - Strip mucosa from one side
  - Remove excess bone, leave behind mucoperiosteum
  - Wedge into defect
Lorenz RR, Dean RL, Hurley DB, Chuang J, Citardi MJ. Endoscopic reconstruction of anterior and middle cranial fossa defects using acellular dermal allograft. Laryngoscope.
Prosser, J et al. traumatic Cerebrospinal fluid Leaks. The Otolaryngologic clinics of North America.
Repair - Ethmoid/Cribiform plate

- Fibrin glue
- Packing -
  - gelfoam
  - Nonabsorbable
Repair-Sphenoid Sinus

- Similar ideas for repair
- Do not strip mucosa too far laterally
Repair-Frontal sinus

- Instrumentation
- Stent
Successful Repair

- 2012
- Psaltis, et al
- Systematic Review of Endoscopic Repair of CSF leaks
- 90% - primary surgery
- 97% - secondary surgery
Antibiotics

- Controversial
- Perioperative
- Post-op
- Packing
- Majority of meningitis occurs in first year, decreases with time
- Persistent leak - always risk
Lumbar Drain

- Decrease ICP and Reduce flow through defect
- Intracranial hypertension
- Consider if initial management fails
- Increases length of stay

Prosser, J et al. traumatic Cerebrospinal fluid Leaks. The Otolaryngologic clinics of North America.
Post-op

- Deep extubation
- Elevate Head of Bed
- No straining, nose blowing, heavy lifting
- Imaging
- ICU

Prosser, J et al. traumatic Cerebrospinal fluid Leaks. The Otolaryngological clinics of North America.
Management

Alternate Scenario

- Delayed diagnosis
Diagnosis- post op

- Clear nasal drainage
  - May be related to posture
  - Retained saline rinse?
  - Salty, metallic
- Changes in smell
- Headache, may improve after rhinorrhea
- Pneumocephalus
- Meningitis
- Brain abscess

Prosser, J et al. traumatic Cerebrospinal fluid Leaks. The Otolaryngologic clinics of North America.
Evaluation

- **Exam**
  - Lean forward, valsalva
  - Halo sign
  - Endoscopy
    - Glistening mucosa

- **Labs**
  - Glucose
  - B-2 transferrin
  - B-trace protein
Glucose

- Glucose Oxidase test strips
- High false positive rate
  - Tears, mucus
  - False negative - bacterial meningitis
**B-2 transferrin**

- Preferred marker of CSF
- Need adequate sample
- Frozen
- Limit transportation time
- Result time
- Detected in aqueous humor, chronic liver disease, rare glycoprotein disorders
B-trace protein

- Produced by meninges/choroid plexus
- Also in other bodily fluids but lower concentrations
- Unreliable - renal insufficiency, bacterial meningitis
Imaging

- CT
- CT cisternography
- Nasal endoscopy with Intrathecal Fluorescein
- Radionuclide Cysternography
- MRI (cysternography)
CT cisternogram

- Skull base CT in axial plane $\rightarrow$ 5-7 ml of nonionic contrast in intrathecal space $\rightarrow$ head down $\rightarrow$ confirm flow with fluoro $\rightarrow$ valsalva $\rightarrow$ coronal/axial CT

- 80% success
Nasal Endoscopy with Intrathecal Fluorescein

- Off label
- Requires LP
- Lean forward, examine

Complications of intrathecal fluorescein – reports of grand mal seizures, death
  - Complications are isolated and occur at high dose
    - Keerl et al – low dose (<50mg) is unlikely to cause adverse events
    - Recommended dilution – 0.1 mL of 10% fluorescein (IV preparation) diluted in 10 cc of pts CSF
Radionuclide Cysternography

- Various radiolabeled tracers such as:
  - Radioactive Iodine labeled serum albumin (RISA)
  - Diethylenetriamine/pentaacetic acid (DTPA)
- Requires LP
- Scintillation Camera detects radiolabeled tracer
- Intranasal pledgets placed in areas of concern and are assessed with gamma counter 12-24 hours later
- Elevated pledget: serum count ratio consistent with a leak
Radionuclide Cysternography

- Drawback
  - poor spatial visualization

Medscape. CSF Leak Imaging.
Repair

- Location
  - Ethmoid Sinus Roof and Cribriform Plate
  - Sphenoid Sinus
  - Frontal Sinus
Persistent Leak

- Insufficient localization of defect
- Previous surgeries
- History of craniotomy
- History of radiotherapy
- Intracranial infection
- Intracranial hypertension

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Complications

- Pneumocephalus
- Subdural hematoma
- Intracranial hemorrhage
- Contusion
- Cerebritis
- Meningitis
- Abscess
Complications

Head and neck imaging, CH. 5
Complications
Complications
Complications
Complications
Prevention

1. Assess the integrity of the skull base on a coronal computed tomography (CT) scan.
2. Identify the Keros class of the medial skull base on a coronal CT scan.
3. Estimate the posterior ethmoid height and the slope of skull base on coronal and sagittal CT scans.
4. Avoid medial and superior dissection during ethmoidectomy.
5. Penetrate the basal lamella medially and inferiorly.
6. Identify the skull base at the sphenoid face, and then dissect the skull base retrograde.
7. Use a 0-degree scope for ethmoid dissection and a 30-degree scope for skull-base dissection.
8. Palpate behind all septations before removal.

Septoplasty

- Delayed
- Injury –
  - Stress forces transmitted to cribriform via perpendicular plate of the ethmoid bone
- Exam-
  - Slit type defects at horizontal lamella of cribriform plate

Balloon sinuplasty

- Case report
- 36yF
- 3 weeks after frontal sinus balloon sinuplasty presented with fever, headache, nausea
- Tip of device penetrated through lateral lamella of the cribiform plate intraoperatively

Tomazic, P et al. Ethmoid Roof CSF leak following frontal sinus balloon sinuplasty. Rhinology
CASE AE

- **History:**
  - Diagnosed with encephalocele in 2006
  - Clear rhinorrhea x 1 year
  - Recently underwent esophageal surgery with prolonged intubation
CASE AE

- Exam:
  - Polypoid structure obscuring right nasal passage
CASE AE

- Imaging
References

- Cummings. Otolaryngology Head and Neck Surgery. Ch. 54, CSF rhinorrhea.
- Som, P and Curtin, H. Head and Neck Imaging. 5th edition. Ch. 5
- Tomazic, P et al. Ethmoid Roof CSF leak following frontal sinus balloon sinuplasty. Rhinology. 2010
Danger points, complications and medico-legal aspects in endoscopic sinus surgery

W. Hosemann and C. Draf